

U.S. Army Corps of Engineers Coastal Engineering Research Board's Flood-Mitigation Fact-Finding Mission to the EU

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Why did the Corps send the CERB to the EU?

- The Corps is implementing a systems approach in water resources development and management
 - from the watershed to the coasts, and all the associated activities and projects
- Katrina elevated the immediacy of the need for a systems approach to flood risk mitigation in the US
- The Corps can learn from EU response to their own flooding crises

Perspective: The EU and the US

- EU is a loose confederation of countries
 - They have agreed to come together to write policies around issues and concerns that affect all of them and require cooperation/collaboration
 - this is all very recent
- The US has been a federal collection of states for 200+ years
 - We came together for concerns of national defense and interstate commerce
 - Very different objectives from the EU

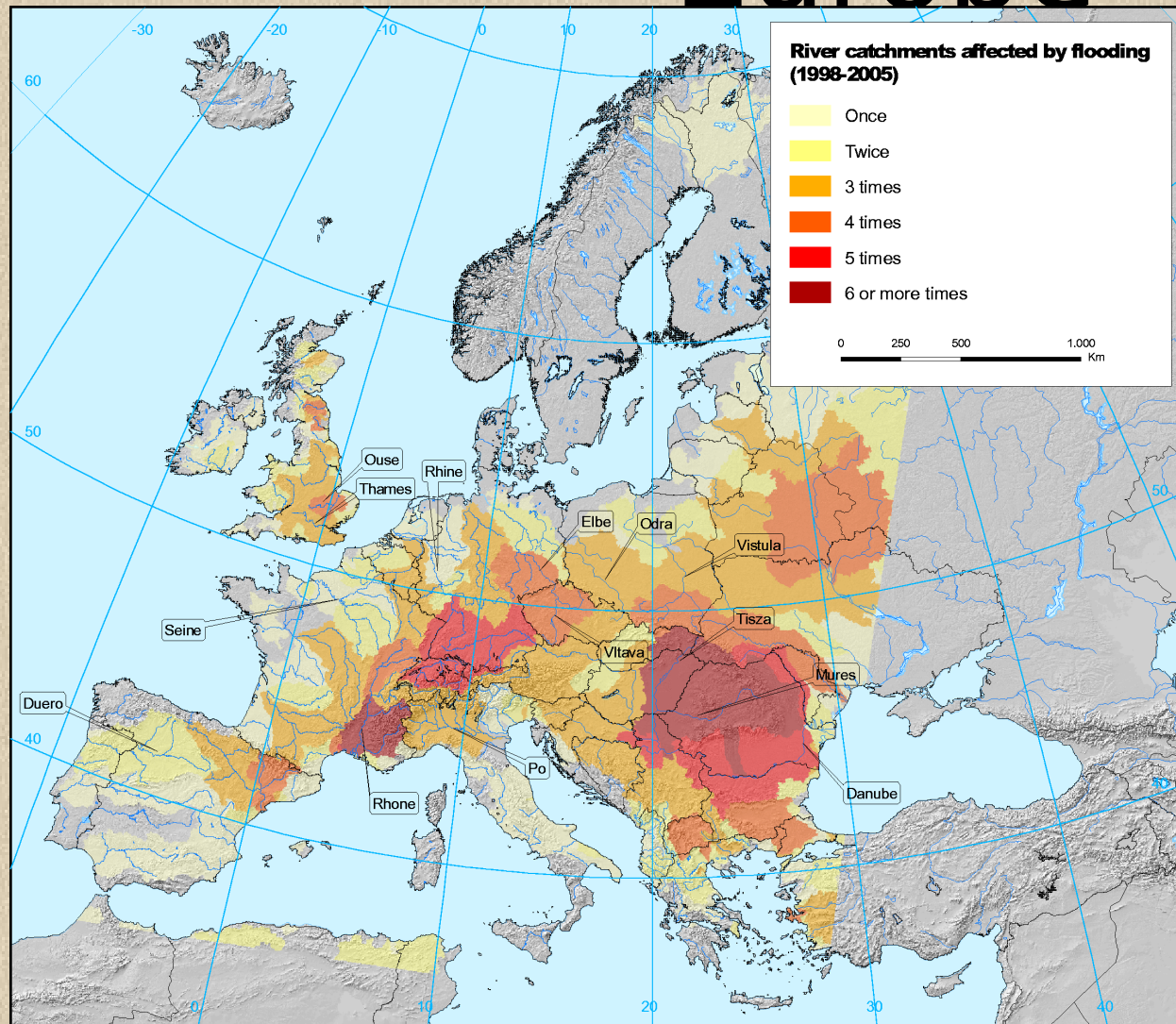
Perspective: The EU and the US

- The EU taxation system is different than the US
 - Most of taxes stay with countries, very little goes to the EU
 - It is the opposite for US
- The EU has general policies such as flood mitigation
 - The countries implement their own versions of those policies with their own resources
- The US does not have general policies for overarching concerns like flood protection

An example of a US National Policy: The Clean Water Act

- The Clean Water Act defines a national policy
 - The implementation is regulatory and procedural
 - The principal enforcement is fines against violators from the private (corporate, individual) to public (federal, state, local) sectors
- In the EU, the enforcement of EU policies is fines against the country
 - It is up to the country to regulate its own corporations and individuals

Scope of Flooding in Europe



Between 1998 - 2002:

- 100 major floods
- 25 billion Euro's insured damage
- 0.5 million people displaced,
- 700 fatalities

(EEA, 2004)

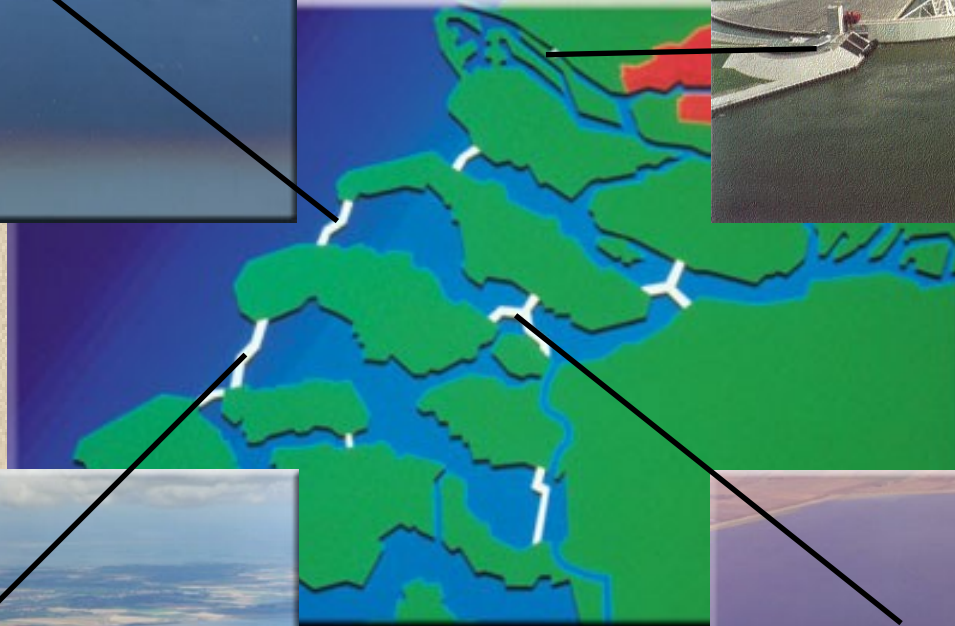


The Netherlands Flood of 1953

**1835 dead
72,000 evacuated
500 km dike damaged
2000 km² flooded**



Deltaworks



Courtesy of M. Tall

National approaches to flood mitigation – Netherlands (1)

- While implementing their 50-year Delta works projects, in response to the 1953 flood, they learned that
 - The “protection” in “flood protection” is a misnomer
 - Flood risk mitigation is more realistic
 - Flood risk reduction solutions need to be an integrated solution addressing both flood risk reduction and environmental needs
 - They were glad it took 50 yrs to build the Delta projects because they learned and adapted along the way
 - **“Use steel and concrete where you must, but sand, sediment, and eco-engineering where you can.”**
 - **Apply “incremental adaptive management/restoration (methods) - an adaptive strategy allows for greater flexibility in the future”**

National approaches to flood mitigation – Netherlands (2)

- Their 50-year flood protection project also taught them
 - Protection cannot be at the cost of the ecosystem without economic and humanitarian consequences
 - **“Mother Nature is the best engineer, think twice before you interfere”**
 - **“Put Mother Nature on the team”**

National approaches to flood mitigation – Netherlands (3)

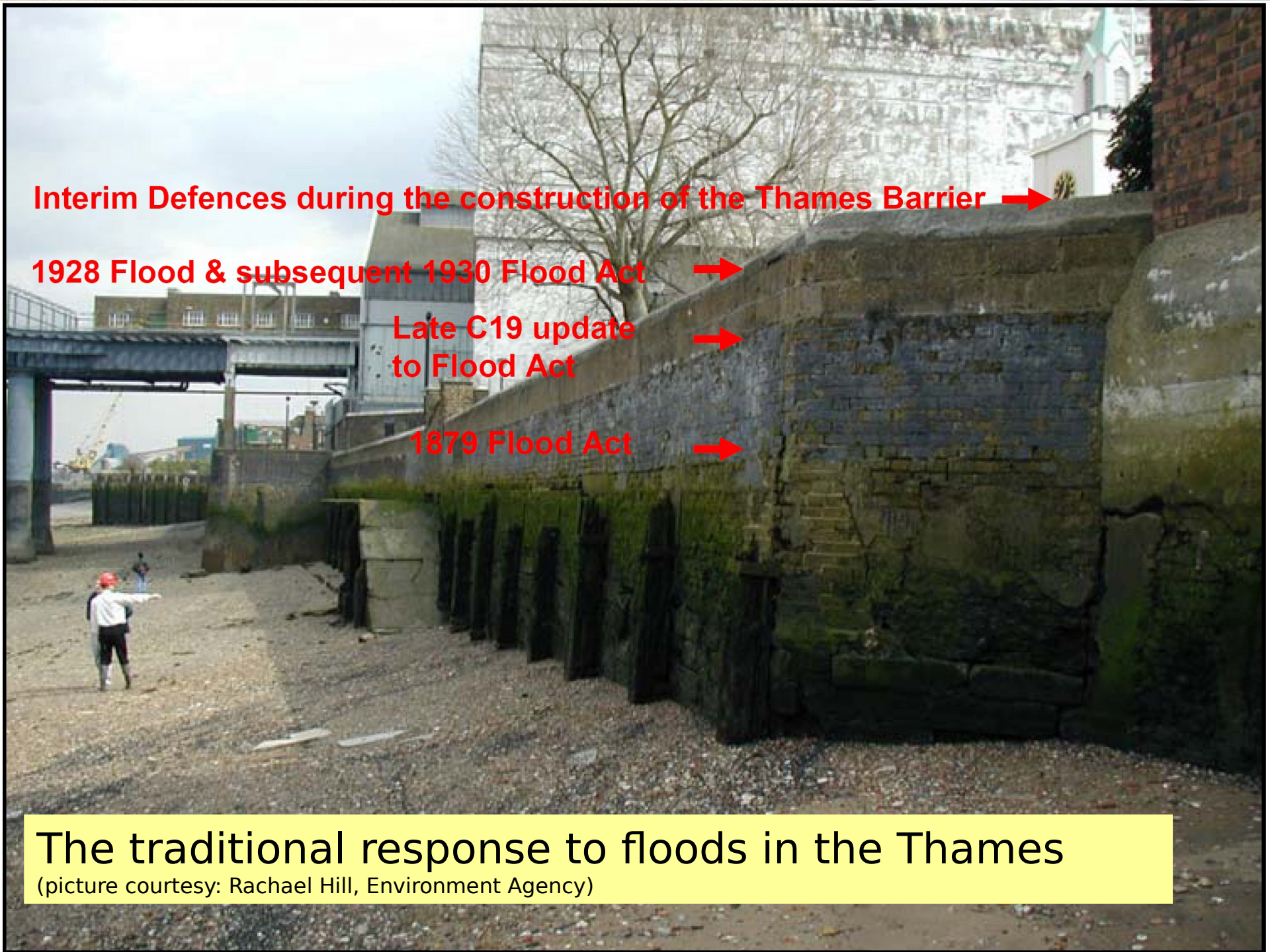
- The Dutch have recently recognized that a concern comparable to storm surge at the coast is flooding from the watershed
 - Managing river flooding requires cooperation with other countries upstream
 - accomplished through the EU policy
 - Flooding from rivers is expected to increase because of climate change
 - The systems solution needs to **“make room for the river”**
 - Areas are now designated for occasional flooding

Dutch Reflection

- Katrina surprised and upset the Dutch – it hit close to home and highlighted their own vulnerabilities
 - In particular, their need to develop evacuation plans and emergency repair plans
 - They had previously operated under the assumption of zero probability of failure of their protection structures

A look at national approaches to flood mitigation – The UK





Interim Defences during the construction of the Thames Barrier →

1928 Flood & subsequent 1930 Flood Act →

Late C19 update
to Flood Act →

1879 Flood Act →

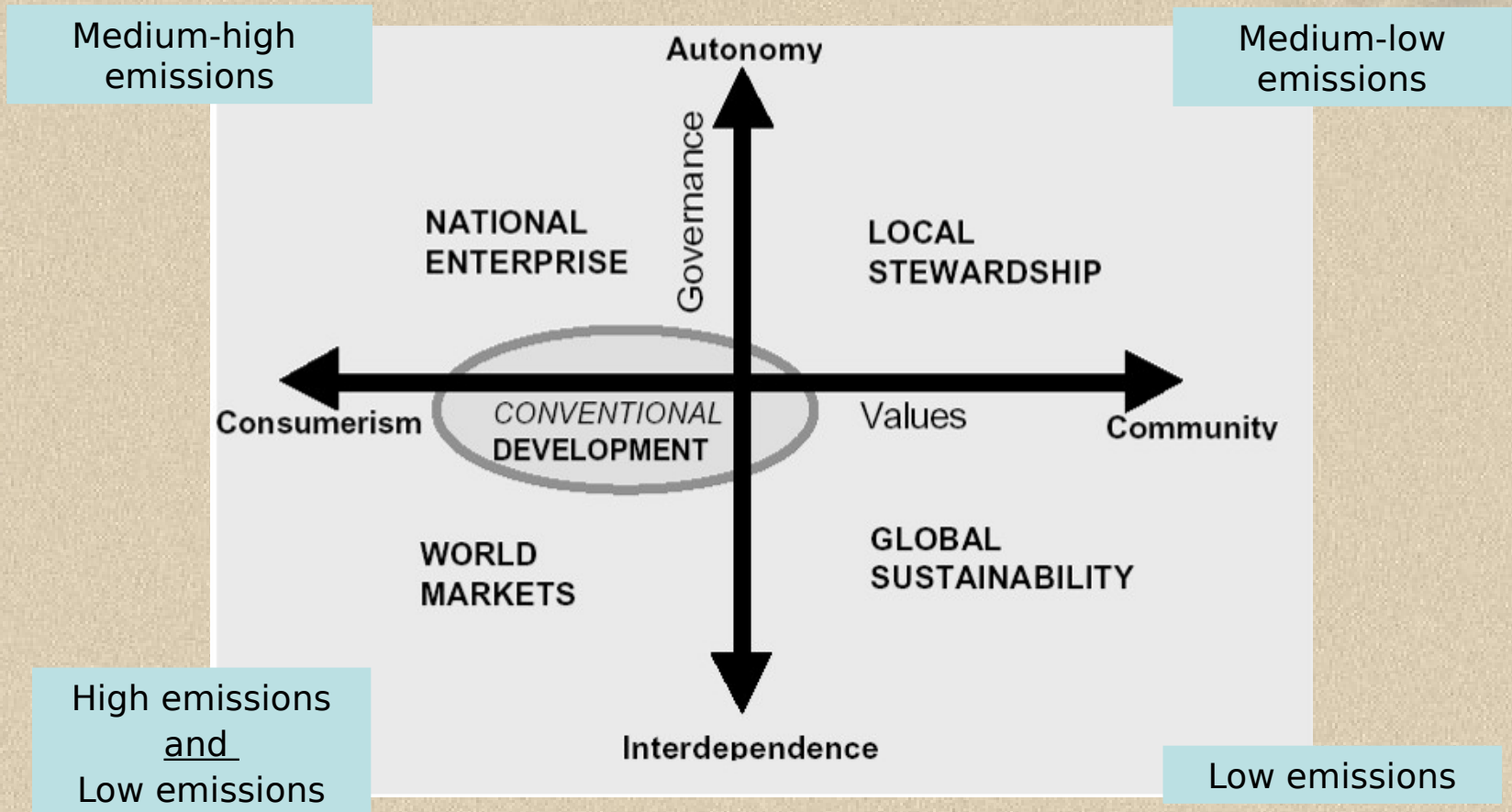
The traditional response to floods in the Thames

(picture courtesy: Rachael Hill, Environment Agency)

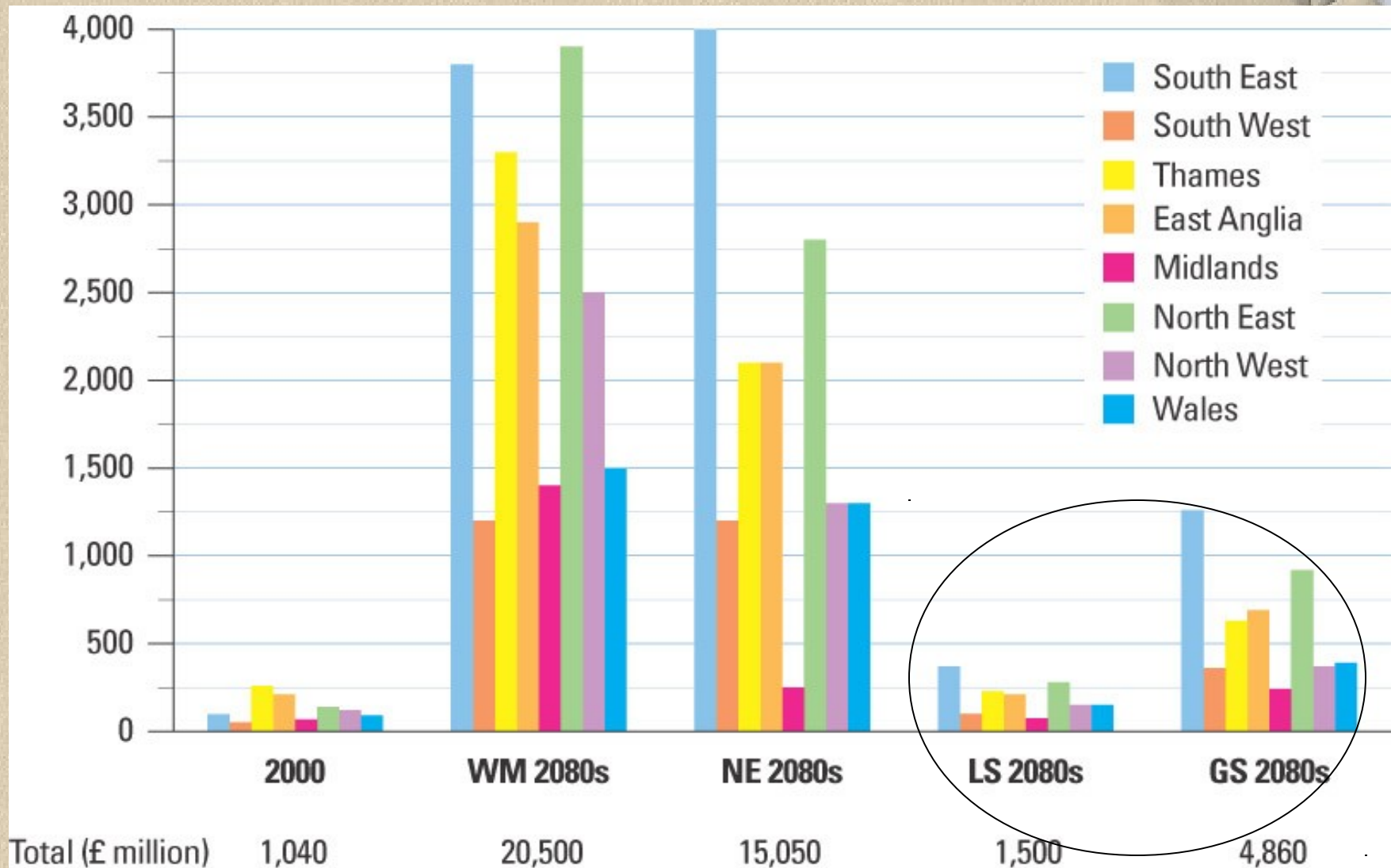
Foresight: a recently completed study on flood risk

- A national-scale look at flood risk potential in the UK given different scenarios of climate and socio-political futures over the next 30-100 years.
 - Climate change scenarios based on IPCC report
 - e.g., sea level rise and rain fall rates
 - Socio-political, long-term “futures” are organized into four possible scenarios in which social, economic, and technical changes may evolve:
 - World market – internationalist, libertarian
 - National-enterprise – nationalist, individualist
 - Local stewardship – localist, cooperative
 - Global sustainability – internationalist, communitarian

Foresight Futures 2020 + UKCIP2002 climate change scenarios



Expected annual flood damage for different climate change scenarios: £ millions (currently ~ £1billion)



Responses with the most potential for risk reductions

- Structural: Coastal Defences
- Non-structural: Land-use Planning & Management

Legend

Colour code	Interpretation
	Major reduction in flood risk ($S < 0.7$)
	Marked reduction in flood risk ($0.7 < S < 0.9$)
	Minor reduction in flood risk ($0.9 < S < 1.0$)
	Ineffective ($S = 1$)
	Likely to Increase flood risk ($S > 1.0$)

Responses Groups ranked by potential risk reduction in the 2080s				
Rank	World Markets	National Enterprise	Local Stewardship	Global Sustainability
1	River Defences	River Defences	Land Use Planning and Management	Land Use Planning and Management
2	Coastal Defences	Coastal Defences	Flood Proofing Buildings	Catchment-Wide Storage
3	Flood Proofing Buildings	Reduce Coastal Energy	Individual Damage Avoidance	River Defences
4	Reduce Coastal Energy	Realign Coastal Defences	River Defences	Coastal Defences
5	Morphological Coastal Protection	Morphological Coastal Protection	Catchment-Wide Storage	Flood Proofing Buildings
6	Realign Coastal Defences	Coastal Defence Abandonment	Pre-event Measures	Rural Conveyance
7	Real-time Event Management	Flood Proofing Buildings	Real-time Event Management	Realign Coastal Defences
8	River Conveyance	River Conveyance	Engineered Flood Storage	Reduce Coastal Energy
9	Individual Damage Avoidance	Catchment-Wide Storage	Rural Conveyance	Morphological Coastal Protection
10	Pre-event Measures	Land Use Planning and Management	River Conveyance	Engineered Flood Storage
11	Engineered Flood Storage	Engineered Flood Storage	Rural Infiltration	Real-time Event Management
12	Land Use Planning and Management	Real-time Event Management	Manage Urban Runoff	Pre-event Measures
13	Manage Urban Runoff	Pre-event Measures	Flood Water Transfer	Individual Damage Avoidance
14	Flood Water Transfer	Rural Conveyance	Coastal Defences	River Conveyance
15	Catchment-Wide Storage	Rural Infiltration	Realign Coastal Defences	Rural Infiltration
16	Rural Conveyance	Individual Damage Avoidance	Morphological Coastal Protection	Manage Urban Runoff
17	Rural Infiltration	Manage Urban Runoff	Reduce Coastal Energy	Flood Water Transfer
18		Flood Water Transfer	Coastal Defence Abandonment	

Take Home Messages (1)

- The main concern in the EU (and of the Dutch) is the watershed
 - The rivers cannot contain the higher rainfall rates
 - “Make room for the river” is a central theme
 - Rapid snow melts increase Spring flooding
 - Higher evaporation decreases Summer river flows
 - Yielding water shortages and navigation problems
- There is also local concern for coastal inundation
 - Higher wave runup and storm surge increases coastal damage and flooding
 - Sea-level rise is a secondary concern
 - rise predictions over the next century are smaller than storm inundation levels happening today

Take-Home Messages (2)

- The EU engineers (i.e, UK's Foresight) can model risk and consequences country-wide in a format that is useful for policy makers
 - This requires:
 - Configuration of the data base for the inundation zones
 - A big job in the UK ... a bigger job in the US
 - Predicting and identifying changes in this data matrix over time
 - Again, a big job in the UK.... A bigger job in the US
 - Running the flood-prediction models with the climate change scenarios for the various socio-economic/policy forecasts
 - Dependent on ongoing reporting by collaboratives like the IPCC

Perspective: Flood-Risk Analysis at the Corps

- The Corps has been developing a similar framework to the UK Foresight called Risk-Informed Decision Making (RIDM)
- Both Foresight and RIDM provide science-based information for the purpose of reducing risk and costs (economic, social, environmental) to the nation due to flooding and coastal erosion
- Both provide a basis for decision makers to identify highest priority issues and best solutions

Foresight and RIDM - How do the two approaches differ?

- Foresight provides science-based information to national policy makers in a format that easily identifies policy drivers that will affect risk
- RIDM, although similar in its methodology, presently differs in its audience and goals
 - It is a tool for deciding on project alternatives for flood mitigation
 - **The first iteration of this tool is being used for LaCPR & MsCIP**
 - It has not yet been developed to communicate to federal-level policy makers (as does Foresight)
- Colin Thorne, a principal of Foresight, has been to DC since the Netherlands Trip to present to Corps leadership and technical staff

Lessons for the USACE (1)

- The USACE and Dutch and British counterparts, are moving quickly away from discussions about standards (or levels) of protection and moving toward discussions about “levels of risk and risk management”
 - The Dutch are moving away from of mitigation through structures towards more balanced approaches
 - The UK is filling a national flood-policy vacuum with a risk-based approach to planning
- Clearly, the US/USACE needs to have continuing dialogue with the Dutch and Brits, and others in the EU

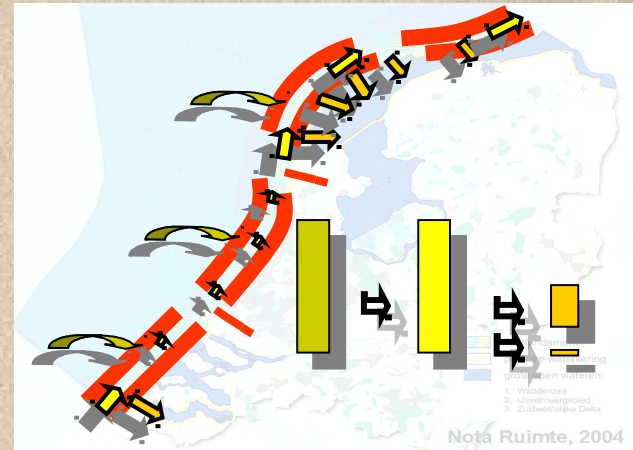
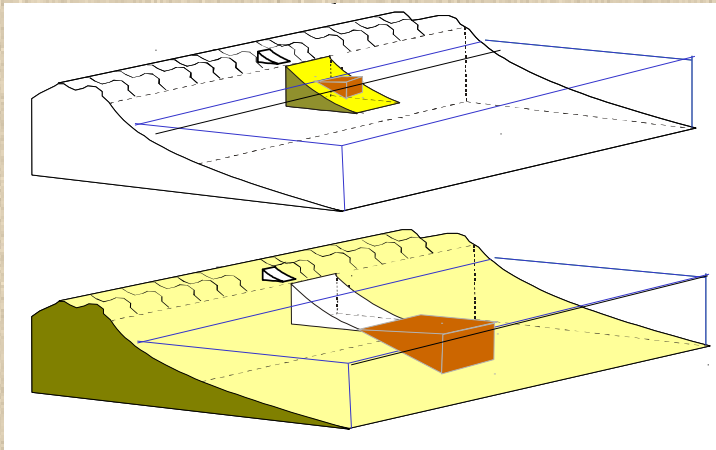
Lessons for the USACE (2)

- Changing rainfall and snow melt rates are the dominant concern in the EU
 - these changes could dominate the Corps mission in this century
 - design standards must include anticipated increases and decreases due to climate change
- Sea level rise may be a minor factor in coastal flooding in the EU
 - the Corps may also want to concentrate on predictions of increased storm intensities and numbers instead of just sea level rates

Lessons for the USACE (3)

- The EU has regional flood-mitigation policies that cross country boundaries
 - Each EU country implements its own versions of those policies with its own resources
 - The EU fines countries that are not meeting those policies
- The US needs to consider developing national policy that would allow for regional, multi-state management of watersheds and coasts for flood-mitigation

System Approach to Coastal Defence – Netherlands



Dutch National Policy of “Dynamic Preservation” for Coastal Management.

- Sand is ‘the carrier of all functions.
- Established Coastal Foundation Zone (Long Term) as the area between dunes and -20 meter contour.
- Policy requires that sand balance in this coastal foundation zone must be maintained and, where necessary, restored.
- Put “Mother Nature” on the Team.

Recommendation #1:

Enhance US Capabilities through further Cooperatives with the EU

- Establish a cooperative agreement between the USACE and an comparable agency in the United Kingdom
 - Similar to the one now in place with Rijkswaterstaat of the Netherlands

Recommendation #2: Provide for On-going Monitoring and Adaptive Management in an Era of Climate Change

- Monitor, review, and assess project performance and condition at appropriate intervals over life-cycle, irrespective of project ownership
- Make commitment to anticipate and facilitate changes to a project as knowledge increases and physical situation evolves
- Provide sustainable funding for this capability

Definition: Adaptive Management

- Working with the natural system to:
 - Allow beneficial natural processes to occur
 - Define extremes and forecast trends in light of best climate change predictions
 - Accommodate significant linkages with other systems through both structural and nonstructural solutions
 - Consider sediment as a manageable and valuable resource
 - Adapt and adjust to changing climate

Recommendation #3:

Provide for System-based Management

- Division Commanders should work with regional associations of states to develop regional strategies
 - Strategies need to consider the entire system: physical drivers, infrastructure, environmental, economic, and social-behavioral factors
- Develop a federal consortium to effectively communicate risks to local land use managers and public to promote informed decision making
- Facilitate the optimum integration of all Corps activities (e.g., flood-risk mitigation, navigation projects) for greater cost effectiveness and maximum system benefits

Recommendation #4:

Provide for Risk-based Management

- Develop and integrate multi-tiered flood plain databases to support assessment of risks, conditions, and consequences
- Develop and maintain an interdisciplinary tool-set for analyzing changing risk and reducing the uncertainty in our risk estimations
- Develop flood risk management plans that assess the potential for compounding hazards (mud flows, debris, hazardous materials)
- Help regional associations of states and federal partners adapt practices based upon changes in risk

Recommendation #5

Adopt Dutch Approach to Include the Geologic Framework in Regional Sediment Management

- Develop Technical Basis to support a National Policy for Sustainable Dynamic Preservation of Coastline.
- Regional Sediment Management includes maintaining the natural sediment system.
- Translation:
 - Human intervention has reduced net sediment reserve in the coastal system.
 - Reduced sediment reserve increases risk of storm damage, coastal erosion, and ecosystem degradation.
 - Mitigating losses by re-constructing the natural system supply is in the Federal, State, local, and

Another Dutch Quote

- **“Lord give us this day our daily bread and every once in a while a flood ...so people are reminded of the risks they still face”**
 - **Marcella Laguzzi, Head - Section Flood Protection, Province South Holland**
- **Translation - Complacency is one of our greatest foes**